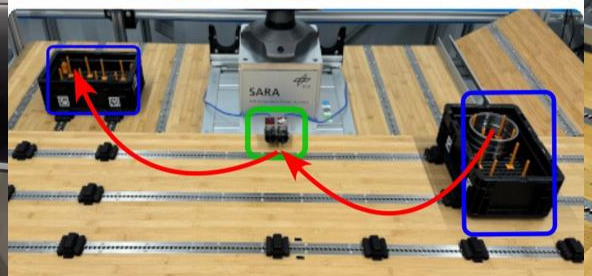
Maximilian Mühlbauer, Markus Knauer, Stefan Schneyer, João Silvério

Learning Robotic Skills from Demonstration

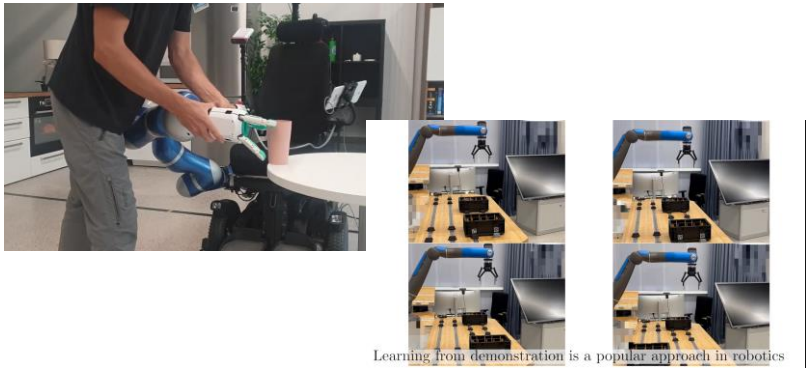


Motivation

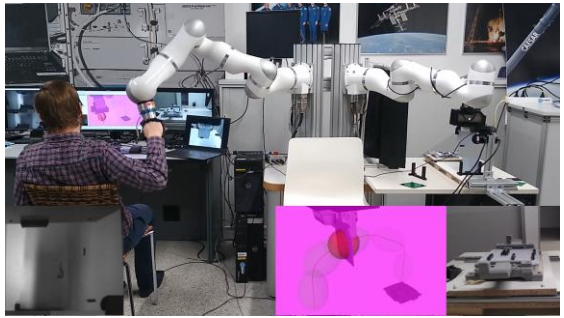
- Programming robots for novel tasks is hard
  - Learning from human demonstration is a promising approach
  - Probabilistic approaches with additional information allow to deal with limited data
  - Open problems: best representation, combination of different tasks, refinement

- Projects are geared towards scientific publications / a subsequent Master's Thesis

Motivation


Learning from demonstration is a popular approach in robotics

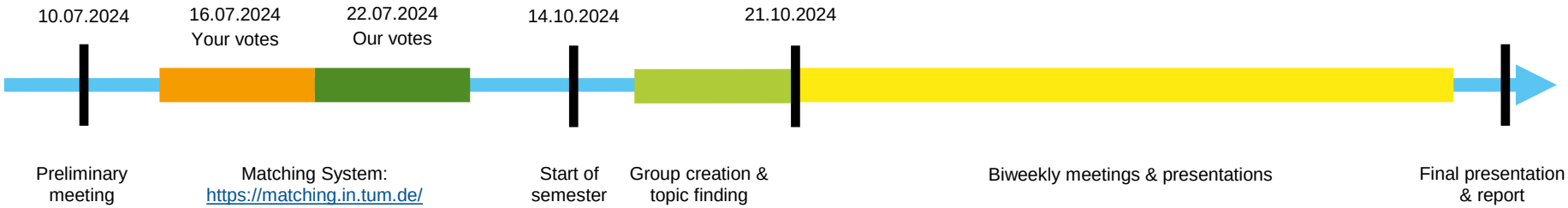

RMC GARAGE




SARA
isodes: 25
DLR

Our approach permits users to build on an
initial model, trained from a few demonstrations

Course Organization & Timeline

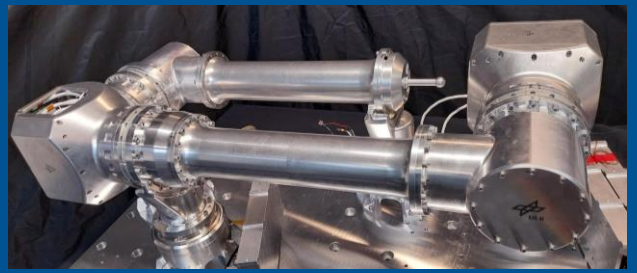


- Projects will be conducted in teams of two students
  - We will suggest a range of topics in the first meeting
  - Feel free to discuss your own ideas
- Bi-weekly meetings with progress presentations (Wednesday 1pm-3pm)
  - Your group presents every 4 weeks
  - Discussion with your supervisor
- Final report and presentation at the end of the semester

Potential Projects

- Based on active research topics
- Tailored to produce new results → potential publications, Master‘s Thesis, …

- Please contact us if you have own ideas in the presented topics!

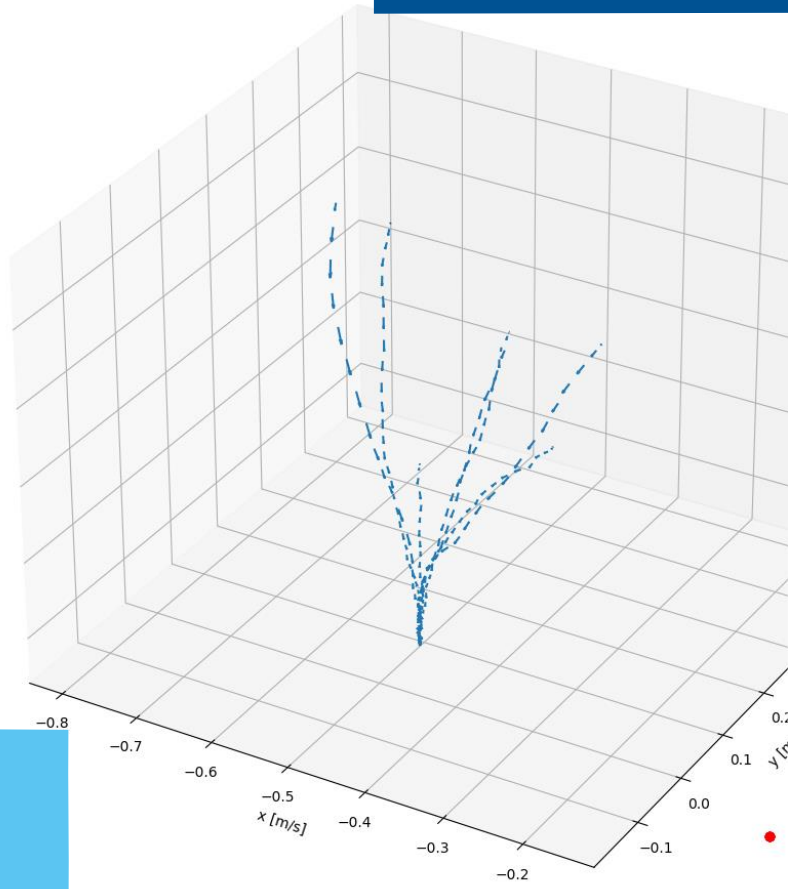


Dynamical Systems Learning

- Learning dynamical systems $\dot{x} = f(x)$ from demonstrations
- What is the best model of a dynamical system?
- How can dynamical systems be adapted?
- How can dynamical systems be fused with other methods?

- Possible project topics:

1. Probabilistic deep learning of dynamical systems
2. Task-parameterization of dynamical systems
3. Adding via points / deforming dynamical systems

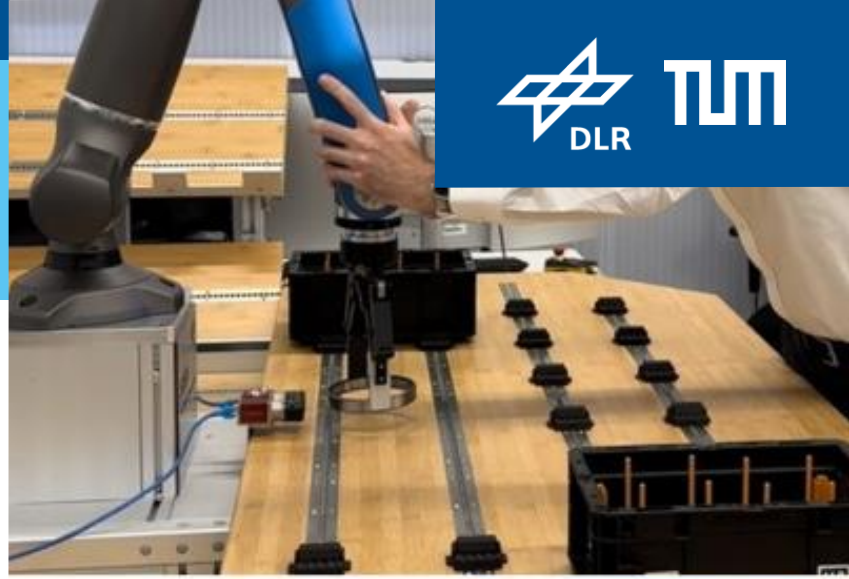


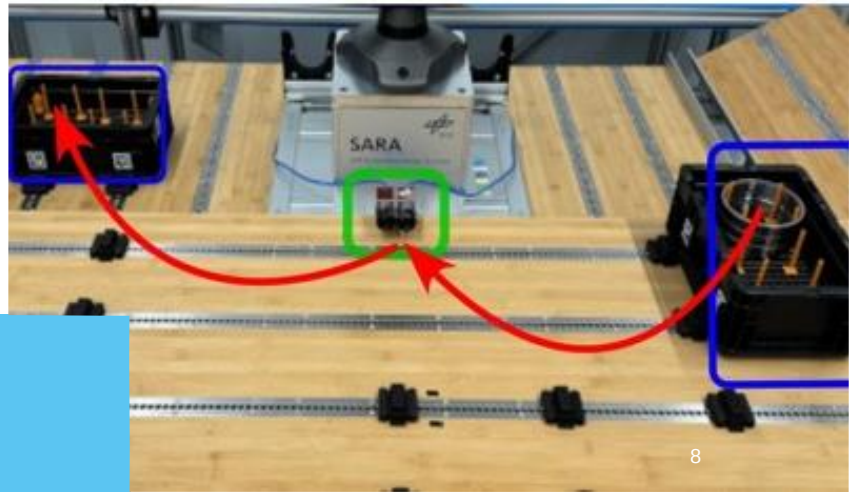
Interactive Incremental Imitation Learning

- Learning based on demonstrations
- Local learning allows generalization
- Adaptation by using via-points

- Possible project topics:

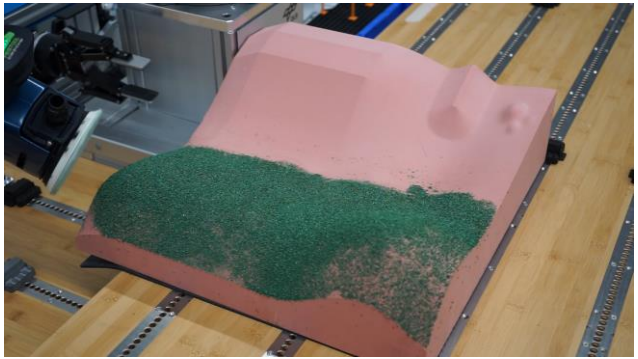
1. Intuitive online via-point modulation (visualization, adding, editing, removing)
2. Using LLMs to adapt motion primitives





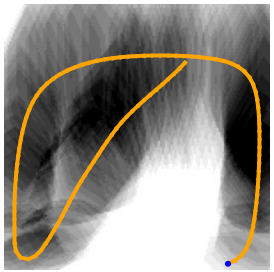
Learning Surface Finishing from Demonstration

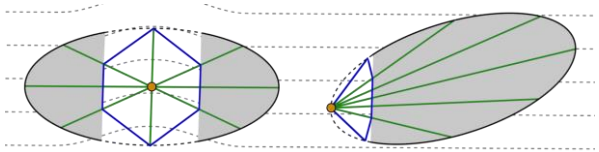
- Challenges: tool contact, tool effect, surface quality
- Parameterize / enhance surface finishing skills
- Planning trajectories online using ergodic control



- Possible project topics:

1. Investigating finite horizon formulations
2. Learning effect, quality model from demonstrations
3. Learning and adapting online desired coverage from external inputs





Prerequesites

- Good programming skills
  - Python, NumPy
  - Potentially PyTorch
- Theoretical Knowledge
  - Robotics
  - Machine Learning
- Curiosity and passion for solving problems
- Good communication skills within the team and towards the supervisor




Please email information about your prior experience (CV, transcript, code etc.) to maximilian.muehlbauer@tum.de before July 16th

Time for Questions!